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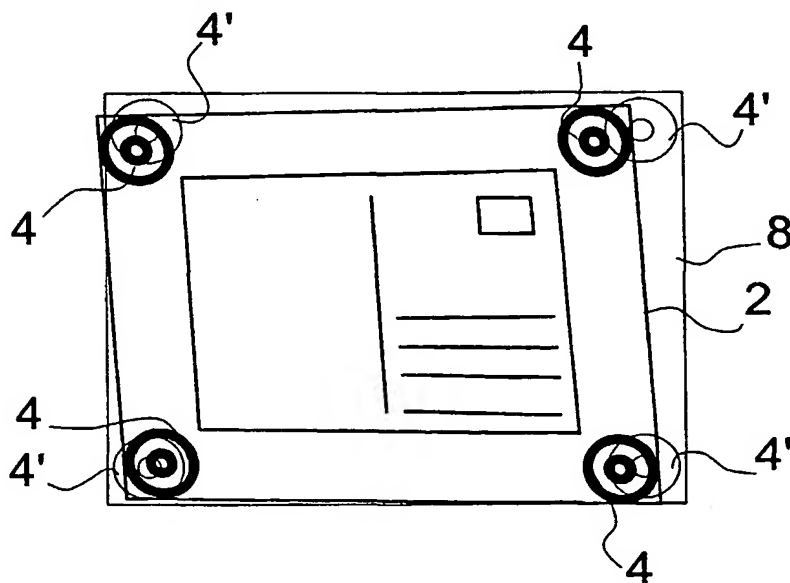
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(54) Title: METHOD OF PRODUCING ELECTRONIC POSTCARDS



(57) Abstract: A method of producing, mailing and displaying electronic postcards having a first and a second information page (1, 2) is provided, said second information page (2) provided with a frame (7). By means of four register marks (4) arranged on a white surface a photographed image (8) of the white surface may be corrected for perspective distortion and trimmed by detection of the presence of the four register marks (4). The contrasts and positions of the register marks (4) are measured, and the colour image of the white surface (8) is subsequently transformed such that the register marks (4) form a rectangle. The brightness and contrast of the transformed colour image are then adjusted dynamically and a subsequent trimming of the transformed and contrast-adjusted colour image is carried out in such a manner that the image substantially only comprises the

frame (7). The final result is stored together with the first information page (1) as an electronic postcard on the data processing equipment. The storage of the first and second information page (1, 2) of the electronic postcard is effected such that the first information page (1) is publicly displayed, while the second information page (2) only is displayed after an access code to the electronic postcard has been entered. As a result a method of producing electronic postcards is obtained, which may be exploited by more simple means than hitherto.

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— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

Title: Method of producing electronic postcards.

Technical Field

The invention relates to a method of producing, sending and displaying handwritten electronic postcards of the type described in the preamble to claim 1.

5 Background Art

It is known to produce, send and display electronic postcards. It is also known that an image of a text page taken by means of a conventional photochemical or electronic (digital) camera often is affected by perspective distortion, as it is often impossible to make the plane of the text page completely parallel to the focal plane of the  
10 camera. It is desirable to manufacture handwritten postcards in a more simple manner dispensing with a digital image scanner or a photocopier for space-saving reasons.

Brief Description of the Invention

The object of the invention is to provide a method of producing electronic postcards  
15 which may be exploited by more simple means than hitherto.

The method according to the invention is characterised in that the presence of the four register marks is detected by means of the equipment, that the brightness, contrast, colour and position of the register marks are measured, and the colour image of the white surface subsequently is transformed by means of the measured  
20 positions of the register marks in such a manner that the register marks form a rectangle, and further that the brightness, contrast and colour of the transformed electronic colour image is adjusted dynamically in relation to the transformed colour image by means of the measured brightness, contrast, colour, and moreover that the

transformed adjusted colour image is trimmed so as to substantially only comprise the centrally arranged frame, and finally that the end result is stored together with the first information page as an electronic postcard on the electronic data processing equipment. As a result an electronically registered colour image of a text page is  
5 obtained, the edges thereof being substantially parallel to the edges of the image. In other words the photographed and manipulated file resembles a scanned, adjusted and trimmed file. The electronic data processing equipment may be a computer, several computers connected in a network or a machine specifically designed to this purpose or a network server. The use of an image scanner or the like equipment is thus  
10 avoided, whereby the manufacture of the postcards is simplified.

According to the invention the detection of the four register marks comprises the following steps:

- generating a grey scale image of the colour image of the other information page,
- generating and storing a number of copies of the grey scale image, each copy  
15 having a progressively lower resolution,
- starting with the copy having the lowest resolution searching each of said copies to locate the positions of the four register marks in each resolution, a correlation measure being used for corresponding pixels between the individual copies,
- comparing the positions of the four register marks on the copies with a number of  
20 a predefined, stored register mark position sets, each register mark position set corresponding to a specific perspective angle, and
- rendering a warning signal, if the detected difference between the stored register mark position sets and the register mark position sets of the copies exceeds a predetermined threshold value. An effective and reliable detection of the register

marks is thus obtained.

The algorithm used for detecting the register marks thus operates on a grey scale image of the colour image to reduce the length of time needed for calculating the transformation parameters. An electronically stored colour image typically has a resolution of 24 bit corresponding to about 16.7 million shades. An electronically  
5 stored grey scale (black/white) image has, however, a grey scale resolution of merely 8 bit corresponding the 256 grey tones. As the algorithm only needs to distinguish dark areas from light areas in the image to locate the register marks, 256 grey tones are sufficient for this purpose, whereby the calculation time may be reduced. A  
10 number of positions are accessible from a storage, said positions representing register marks positioned in the corners of predetermined perspectively distorted rectangles. These positions are compared with the detected positions of the four register marks in the grey scale copy of the colour image. A warning function may be built into this part of the algorithm, said function being activated, if the stored rectangles do not  
15 include a' rectangle mating the rectangle calculated by the detection of the four register marks. If a mating rectangle is not found, the warning function may be used to disrupt the further processing of the image, as the resulting transformed colour image would be of an inferior quality.

According to the invention the transformation of the colour image of the white  
20 surface may comprise a division of the quadrangle defined by the four detected register marks into at least two triangles and a subsequent affine transformation of the colour image of the white surface by means of the located register mark positions such that the quadrangle substantially forms a rectangle after the transformation. As a result a non-rectangular quadrangle is transformed into a substantially rectangular  
25 image. In most cases it is sufficient to divide the quadrangle into two adjoining triangles. However, embodiments are also possible, in which the quadrangle is divided into any number of triangles, eg four, eight or sixteen. The higher number of triangles into which the quadrangle is divided, the better the resulting

transformation. However, the calculation time increases correspondingly. The grey scale image is advantageously used for calculating the transformation parameters used on the original colour image.

According to the invention the transformation of the colour image of the white surface may be determined directly by means of the detected register mark positions such that the quadrangle substantially forms a rectangle after the transformation, said transformation determination being performed by solving an equation for the perspective projection of the detected register mark positions. Hereby a higher degree of freedom is obtained when carrying out the transformation. As a result an image of a non-rectangular quadrangle substantially forming a rectangle is obtained.

According to the invention the adjustment of the brightness, contrast and colour of the transformed colour image may include a measurement of the lighting conditions of each of the four register marks and a subsequent exposure compensation thereof, a linear stretch and limitation algorithm and a bilinear interpolation being carried out on the pixels between the register marks, and a suitable colour correction being carried out on the colour image obtained by the exposure compensation so as to reduce any flaws, which may have been enhanced by the exposure compensation. The algorithm is thus able to correct the variations in the brightness, contrast, and colour present in the transformed colour image such that the white surface in the resulting image appears as even as possible. The linear stretch and limitation algorithm displaces the colour histogram representing the differences in colour between two register marks, and the bilinear interpolation smooths out any occurring variations. As the exposure compensation inevitably intensifies any colour engraving (discolouration) in the portions of the image, which is most unevenly exposed, a final colour correction is made of the adjusted transformed image such that the resulting image has a correct colour composition.

According to the invention the storage of the first and second information page of the

electronic postcard may be performed such that the first information page may be publicly displayed, while the second information page only is displayed after a unique access code for the electronic postcard has been entered. An electronic postcard is thus obtained, of which the first information page (the front) is made public after the forwarding of the postcard, while the second information page (the back with the handwritten message) may only be accessed by the intended recipient of the postcard. Depending on the choice of embodiment it is possible to conceal the second information page from everybody else but the recipient or to display it in a blurred illegible edition or to display it in a resolution, which renders the contents thereof illegible. By entering the unique access code of the electronic postcard the recipient gains access to a clear, readily readable edition of the second information page by means of the method described above.

#### Brief Description of the Drawings

A preferred embodiment of the invention is explained in greater detail below with reference to the accompanying drawings, in which

Fig. 1 illustrates a first information page of an electronic postcard,

Fig. 2 illustrates a second information page of an electronic postcard provided with register marks, and

Fig. 3 is an illustration of second information page to be adjusted to a predetermined rectangle.

#### Best Mode for Carrying Out the Invention

The two information pages shown in Figs. 1 and 2 form the two parts of the completed electronic postcard. The information page 1 shown in Fig. 1 may contain

a colour photograph or any optional colour image, while the second information page 2 comprises a frame 7 defining an address field 5 and a writing or message field 6 corresponding to the fields on a conventional postcard, and four register marks 4 positioned immediately opposite the corners of the frame 7. In the preferred  
5 embodiment each register mark is formed as a number of dark and light concentric disks.

In the preferred embodiment the first information page 1 is typically a digital photograph of the sender, while the second information page 2 is a preprinted sheet of paper, eg in A4 size, on which the sender of the electronic postcard writes his  
10 greeting and the address of the recipient in the fields 5 and 6, respectively.

Fig. 3 shows a colour image 8 of the second information page 2, which in the preferred embodiment has been taken by means of a digital camera and shown in Fig. 3 with four theoretic register marks 4', which in practice are invisible. The colour image 8 of the information page 2 is perspectively distorted in relation to the image  
15 rendered of the information page 2 by means of an image scanner or a photocopier. It appears from Fig. 3 that the four register marks 4 of the information page 2 are not coincident with the theoretically correct register marks 4'. The colour image 8 is then electronically manipulated by means of the data processing equipment such that the image 8 resembles the information page 2 in Fig. 2 as much as possible.

20 An embodiment of method may be carried out in the following manner:

It is assumed that the information pages 1 and 2 have been stored in digital form on the electronic data processing equipment which is to perform the calculations. Initially a detection of the register marks 4 may be carried out by generating a grey scale image of the colour image 8 by means of the electronic data processing  
25 equipment.



This grey scale image enables the data processing equipment to produce a number of copies of decreasing resolutions. This means that if the original colour image 8 has a resolution of for instance 1024 x 768 pixels, the first grey scale image also has a resolution of 1024 x 768 pixels, while the subsequent copies of the grey scale image  
5 have resolutions of 512 x 384 pixels, 256 x 192 pixels, 128 x 96 pixels, etc.

The contrast and the positions of the register marks 4 are subsequently measured by searching the copies of the grey scale image, starting with the copy having the lowest resolution, in order to locate the positions of the four register marks 4 in each of the copies having a different resolution. For this purpose a correlation measure for  
10 corresponding pixels between the individual copies may be used. Both the positions and the sizes of the four register marks 4 are found at this search.

The determined register mark position sets 4 in the copies of the grey scale image of the image 8 may now be compared with a set of predetermined stored register mark position sets 4'. Each of these position sets 4' corresponds to a specific perspective  
15 angle, and the electronic data processing equipment may be instructed to issue a warning signal, if the difference between the stored register mark position sets 4' and the register mark position sets 4 of the copies exceeds a predetermined threshold value above which the image 8 cannot be corrected.

20 A transformation of the image 8 usually takes place according to the parameters calculated in the preceding steps, if the difference between the two register mark position sets is small. The transformation may be performed by dividing the quadrangle defined by four register marks 4 into a number of triangles, eg two, and subsequently carrying out a piecewise affine transformation of the image according  
25 to these parameters. As a result the image 8 has been adjusted to a rectangle.

As an option to dividing the plane into triangles the perspective adjustment may be performed by directly solving the equation for perspective projection of a plane. This

is made by determining the nine parameters characterising the orientation of the plane in relation to the focal plane.

The brightness and contrast of the transformed colour image may be adjusted by carrying out an exposure compensation of the result by means of the measured  
5 lighting conditions for each of the four register marks 4. A linear stretch and limitation algorithm as well as a bilinear interpolation may be carried out. Any differences in colour caused by uneven exposure are hereby displaced. The resulting colour image may be colour-corrected to reduced the flaws, which inevitably occur during the exposure compensation.

- 10 The contrast-adjusted colour image 8 may be trimmed to contain only the rectangular frame 7, whereby the register marks no longer are visible.

As a final step the produced information page 1 containing the transformed, colour- and exposure-corrected colour image 8 may be stored on the electronic data processing equipment in such a manner that the first information page 1 is publicly  
15 accessible and the second information page 2 only is accessible by means of a unique access code or the like issued to the persons to whom the postcard is to be sent. In this case the said persons will receive a message in their electronic mailbox notifying them of the existence of the electronic postcard and containing details about the sender, the unique access code and how to fetch the electronic postcard.

- 20 The transmission of the card may in practice for instance take place from a suitable stall or the like comprising electronic equipment such as a computer. The stall may be placed in an amusement park, close to a landmark or at a traffic centre, such as an airport and a train station. It would be possible for the vendor of the postcard to take the electronic photograph to be used on the first information page 1 and to copy  
25 the second information page 2 after a customer has written a message, eg a holiday greeting, and the address in the fields 5 and 6, respectively. When the two

information pages 1 and 2 have been joined into an electronic postcard as described above and when the sender, ie the customer, has accepted the card, the vendor transmits the two information pages to a centrally placed (anywhere in the world) electronic postcard server forwarding the electronic postcard to the recipient, who  
5 may access the postcard as described above.

It is implied that the recipient has access to equipment, which is able to receive and display the postcard, typically a PC or the like equipment linked with a network such as the Internet.

The invention has been described in connection with the manufacture of quadrangle  
10 electronic postcards, but is not restricted thereto or any other respect. It is also possible that card may have other sizes such as pentagonal. The method may furthermore be generally used in connection with adjusting and trimming perspectively distorted images.

As an example the method according to the invention may be used in connection with  
15 photographing packages or the like, a perspective adjustment of the taken images being made on the basis of the register marks present in the image. This feature is advantageous in that the invoice and/or address information attached to the packages may be read by means of a camera. The reading may be performed automatically, the packages passing a camera while being conveyed along a conveyor belt.

20 The method may also be used in other situations, where selected portions of an image are to be perspectively adjusted on the basis of register marks in the image. This feature is of great interest in connection with the recording of sporting events, where the recording may contain boards placed around a sport field or pitch. Information about perspectively adjustment of the boards to a well-defined rectangular image is  
25 determined continuously and used for making an inverse transformation of a selected rectangular image such that the selected rectangular image or portions thereof is/are

transformed on the respective board in the image. By carrying out such a transformation in real time, suitable advertisements or any other information may be supplied continuously to the boards appearing in the recording. As a result the image is manipulated such that the modified recording gives the impression that the added  
5 information actually is printed on the boards. The physical boards need not have any advertisement printed thereon or the printed information may at least differ from the information added to the manipulated recording. This embodiment may for instance be used for presenting different advertisements to different groups of viewers. An advertisement or a presentation may thus be specifically targeted or the presented  
10 information may be customised for local markets at international television broadcasts or the like.

Finally the invention may be implemented such that the method may be used directly in a digital camera during use thereof. The digital camera thus comprises an image recording unit, a control unit, a storage and an output unit. The control unit is  
15 adapted to load image information received continuously via the image recording unit, which comprises a lense and a CCD chip or the like equipment. The control unit is also adapted to process the received image information by means of the method according to the invention, whereby a desired transformation of the image takes place. The manipulated image is then transmitted to the output unit to be stored  
20 thereon or forwarded to external equipment communicating therewith.

Claims

1. Method of producing, sending and displaying handwritten electronic postcards by means of electronic data processing equipment, said postcard having a first and a  
5 second information page (1,2), the first information page (1) containing an electronically registered colour image and the second information page (2) containing an electronically registered colour image of a substantially rectangular white surface (8), whose surface normal not necessarily is parallel to the surface normal of the focal plane of the colour image, said rectangular surface comprising four register  
10 marks (4) positioned in the corners of said rectangular and a centrally arranged frame (7) able to contain a handwritten message, c h a r a c t e r i s e d in that the presence of the four register marks (4) is detected by means of the equipment, the brightness, contrast, colour and position of the register marks (4) being measured, that the colour image of the white surface (8) subsequently is transformed by means of the measured  
15 positions of the register marks (4) in such a manner that the register marks (4) form a rectangle, and further that the brightness, contrast and colour of the transformed electronic colour image is adjusted dynamically in relation to the transformed colour image by means of the measured brightness, contrast, and colour, and that the transformed adjusted colour image is trimmed so as to substantially only comprise  
20 the centrally arranged frame (7), and that finally the end result is stored together with the first information page (1) as an electronic postcard on the electronic data processing equipment.

2. Method according to claim 1, c h a r a c t e r i s e d in that the detection of the four register marks comprises the following steps:

25

- generating a grey scale image of the colour image (8) of the other information page,
- generating and storing a number of copies of the grey scale image, each copy

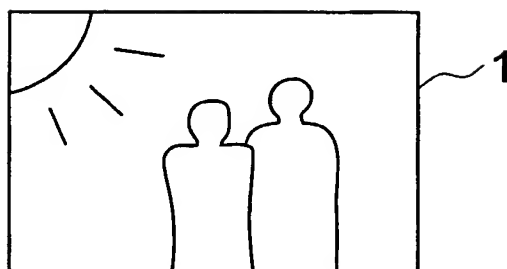
having a progressively lower resolution,

- starting with the copy having the lowest resolution, searching each of said copies to locate the positions of the four register marks (4) in each resolution, a correlation measure for corresponding pixels between the individual copies being used,
  - comparing the positions of the four register marks (4) on the copies with a number of a predefined, stored register mark position sets (4'), each register mark position set (4') corresponding to a specific perspective angle, and
  - rendering a warning signal, if the detected difference between the stored register mark position sets (4') and the register mark positions (4) of the copies exceeds a predetermined threshold value.
3. Method according to claim 1 or 2, c h a r a c t e r i s e d in that the transformation of the colour image of the white surface (8) comprises a division of the quadrangle defined by the four detected register marks (4) into at least two triangles and a subsequent affine transformation of the colour image of the white surface (8) by means of the located register mark positions (4) such that the quadrangle substantially forms a rectangle after the transformation.
4. Method according to claim 1, c h a r a c t e r i s e d in that the transformation of the colour image of the white surface (8) is determined directly by means of the detected register mark positions (4) such that the quadrangle substantially forms a rectangle after the transformation, said transformation determination being performed by solving an equation for the perspective projection of the detected register mark positions.
5. Method according to one of the claims 1-4, c h a r a c t e r i s e d in that the

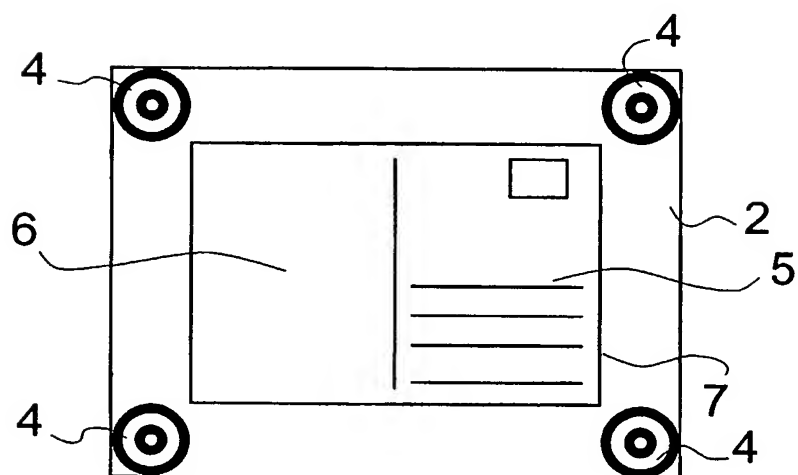
adjustment of the brightness, contrast and colour of the transformed colour image involves a measurement of the lighting conditions for each of the four register marks (4) and a subsequent exposure compensation, a linear stretch and limitation algorithm and a bilinear interpolation being carried out on the pixels between the register marks, and further that a suitable colour correction is carried out on the colour image obtained by the exposure compensation so as to reduce any flaws, which may have been enhanced by the exposure compensation

6. Method according to one or more of the claims 1-5, characterised in that the storage of the first and second information pages (1,2) of the electronic postcard is performed such that the first information page (1) is publicly displayed, while the second information page (2) only is displayed when a unique access code for the electronic postcard is entered.

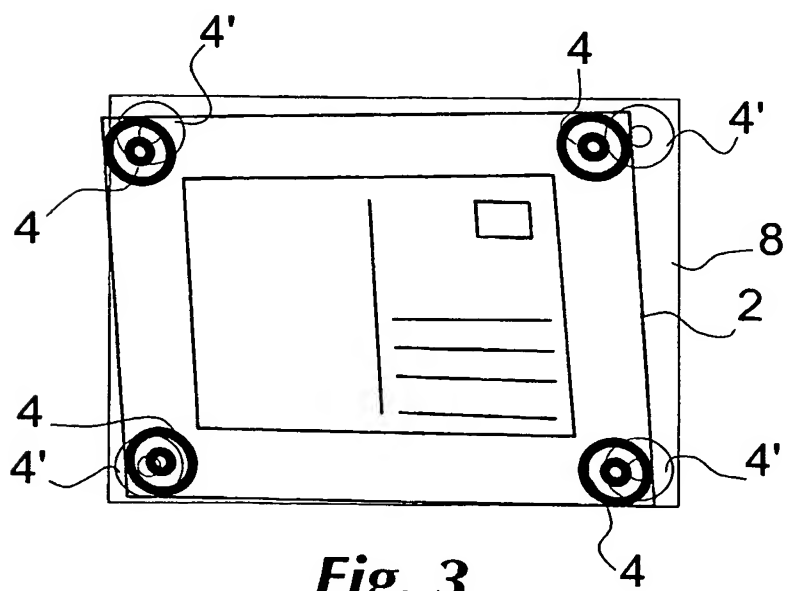
1/1



**Fig. 1**



**Fig. 2**



**Fig. 3**



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## A. CLASSIFICATION OF SUBJECT MATTER

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According to International Patent Classification (IPC) or to both national classification and IPC

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SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI DATA, EPO-INTERNAL

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6018774 A (NEIL L. MAYLE ET AL.), 25 January 2000 (25.01.00), summary  -----	1-6

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

\* Special categories of cited documents:

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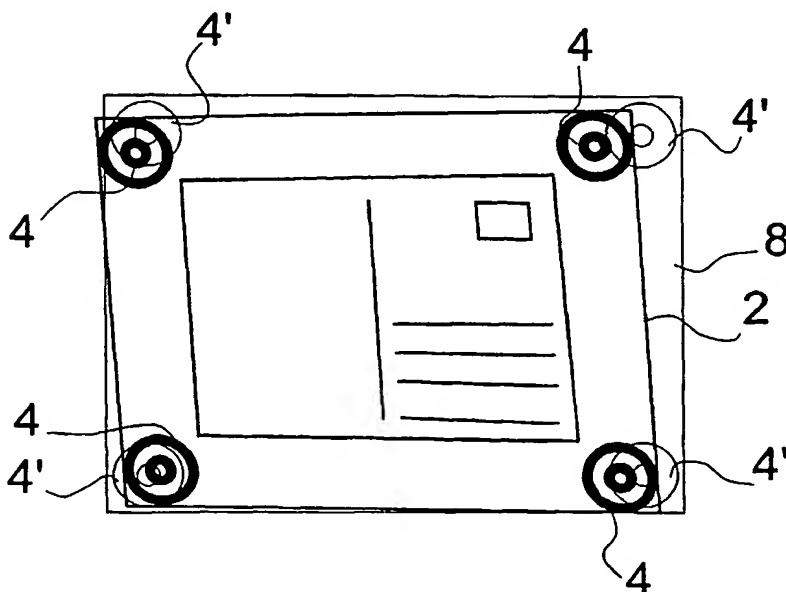
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(57) Abstract: A method of producing, mailing and displaying electronic postcards having a first and a second information page (1, 2) is provided, said second information page (2) provided with a frame (7). By means of four register marks (4) arranged on a white surface a photographed image (8) of the white surface may be corrected for perspective distortion and trimmed by detection of the presence of the four register marks (4). The contrasts and positions of the register marks (4) are measured, and the colour image of the white surface (8) is subsequently transformed such that the register marks (4) form a rectangle. The brightness and contrast of the transformed colour image are then adjusted dynamically and a subsequent trimming of the transformed and contrast-adjusted colour image is carried out in such a manner that the image substantially only comprises the frame (7). The final result is stored together with

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